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ELYTRAL TRACHEATION OF THE TIGER BEETLES (CICINDELIDÆ)*

BY V. E. SHELFORD

I. INTRODUCTION

In course of a study of the relation of the various structures to the color pattern of Cicindela a large number of elytra were mounted in hot balsam and the trachea examined as was described in an earlier paper (Shelford '13). The studies embraced all of the families and subfamilies of the Cicindelidæ of earlier authors. The group is world wide and some of the material has been obtained only with expense and difficulty. The studies have involved the drawings of elytra of many individuals and the results as a whole show the tracheation of the elytra of a large heterogeneous group. A large number of drawings is presented because they are much more satisfactory than description, and some idea of variation and the form of the elytron can be obtained. Fully three times as many individuals as shown, were drawn outside of Cicindela.

The nomenclature used is from Horn's "Index der Cicindeliden". Elytra of Cicindela and Tetracha have been studied fresh, and the amount of asymmetry and variation of different individuals noted.

II. GENERAL STRUCTURE OF THE ELYTRON

1. Chitinous Columns

The two walls of the sac like elytron are held together by chitinous pillars or columns which in the adult appear in cleared elytra as shown in figure 1. The different layers of cuticula show here as rings around the original central spindle. These are often proportionately larger and occupy more of the space than shown in this figure.

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*Contributions from the Zoological Laboratory of the University of Illinois, No. 54.

2. *Hairs*

Hairs which in a primitive insect usually cover the wing entirely are present in nearly all tiger beetle elytra. In the Manticoras the hairs are of two sizes and are usually just in front of the chitinous columns. Hairs in this group are usually located on the posterior side of backward projecting tubercles. Under the microscope the hairs may be located on the pigmented area of the elytra by the light area which is produced by the thin cuticula at the base of each hair. Hairs appear on the whole to be less common in the unpigmented areas and when present usually are surrounded by a narrow rim of pigmented cuticula. Hairs occur in practically all groups though they have been lost from the majority except for a few at the base of the elytron and scattered along the trachea. (See fig. *6, 21-31, 32-42, and 45.*) In *Platychila pallida* I found no indication of hairs. This is the only representative of the Platychilidæ. *Mantichora* (*Mantichoridæ*) (Fig. 2) which stands in close relation to *Platychila* has the dorsal portion of the fused elytra covered very fully with hairs and the epipleuron has only scattered hairs. One of the *Megacephalidæ, Megacephala (Tetracha) æquinoctialis* has the elytron completely and uniformal covered with small hairs. The other species of Megacephala which I have examined ***klugi*** and *limata* show only a few hairs at the base of the elytron (Fig. *43* to *45*).

In the only observed representative of the *Pognostomidæ* which stand at the beginning of the series in W. Horn's classification,

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FIGS. 1-7. STRUCTURE OF THE ELYTRON AND THE MORE GENERALIZED TYPES OF TRACHEATION

Fig. 1. Mantichora tuberculata DeGeer (Africa); Arrangement of columns and hairs.

Fig. 2. Mantichora tuberculata DeGeer (Africa); Distribution of hairs.

Fig. 3. Pognostoma chalybæum Klg. (Madagascar); Distribution of hairs.

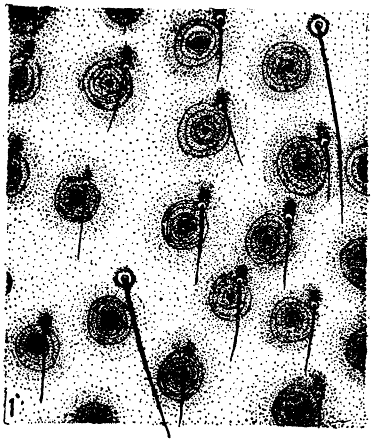
Fig. 4. Amblychila cylindriformis Say (Kansas); Six fully developed trachea.

Fig. 5. Omus Dejeani Rehe (California); Degenerate radius and media.

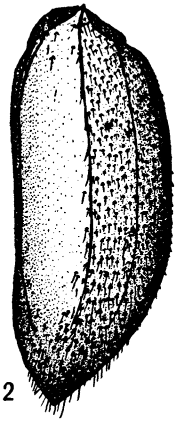
Fig. 6. Collyris sp; Showing reduced cubitus and anal.

Fig. 7. Platychila pallida F. (S. Africa); Reduced anal.

PALAEOMANTICHORIDAE

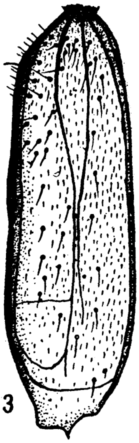


1 MANTICHORA



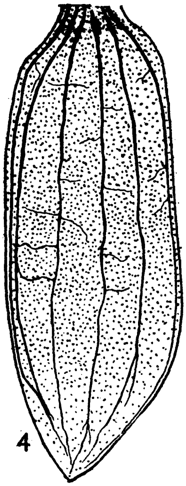
2 MANTICHORA

CTENOSTOMIDAE

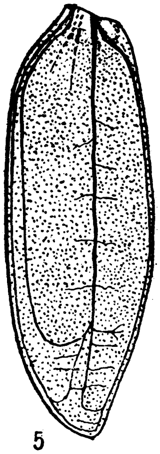


3 POGNOSTOMA

NEOMANTICHORIDAE

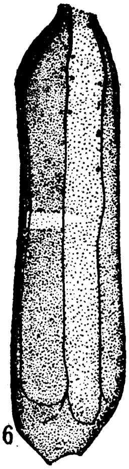


4 AMBLYCHILA



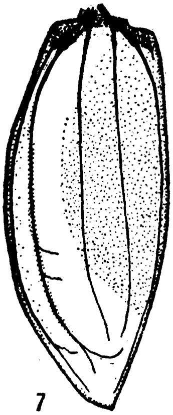
5 OMUS

COLLYRIDAE



6 COLLYRIS

PLATYCHILIDAE



7 PLATYCHILA

PLATE X

the elytra was covered with hairs. In the *Collyridæ* (*Collyris* and *Tricondyla* are arboreal) the hairs are confined to a few at the base and a few scattered along the lines of the tracheæ.

3. Pits and depressions

The elytra of many species are marked with pits. Close examination under the microscope with both transmitted and reflected light shows that, in the majority of cases, the pits are over the center of the chitinous columns and bear no relation to rudimentary hairs as Dr. W. Horn has suggested. I have seen no pits that would appear to represent rudimentary hairs though they may occur.

4. Veins and thickenings

There are sometimes thickenings running lengthwise of the elytron as in Domica (fig. 35 and 36). While these thickenings run parallel with the trachea they are usually between rather than coincedent with them, except in Caledonica (fig. 25). There are

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FIGS. 8-19. ELYTRA OF FRESHLY EMERGED CICINDELAS

Fig. 8. Showing the media, cubitus, and anal (rudimentary in freshly emerged specimens of C. repanda. Dej.

Fig. 9. The same in a freshly emerged C. punctulata Oliv.

Figs. 10-11. Showing in full detail the tracheation of the right and left elytra of a freshly emerged C. Leconti Hald. Note the close similarity of the main trunks and the marked difference in small branches, indicating the lack of significance of these. From two camera lucida drawings of fresh elytra flattened out, one bottom side up.

Fig. 12. Camera drawing of another specimen of the same species. Note the fewer cross branches and the longer radius and media.

Fig. 13. Camera drawing of a freshly emerged C. repanda Dej.

Figs. 14-15. Camera drawings of two individuals of C. punctulata Oliv.

Fig. 16. Camera drawing of a freshly emerged C. cuprascens Lec. Note the degenerate media and heavy cross trachea.

Fig. 17. Camera drawing of a fresh C. hirticollis Say. Note condition similar to that in 16.

Figs. 18-19. Camera drawings of two different individuals of C. tranquebarica Herbst.

In these figures note the branching in every case near the curve of the posterior side of the elytron, and the subcosta ending at the same point with branches extending inward in every case.

CICINDELIDAE CICINDELINI

CICINDELA

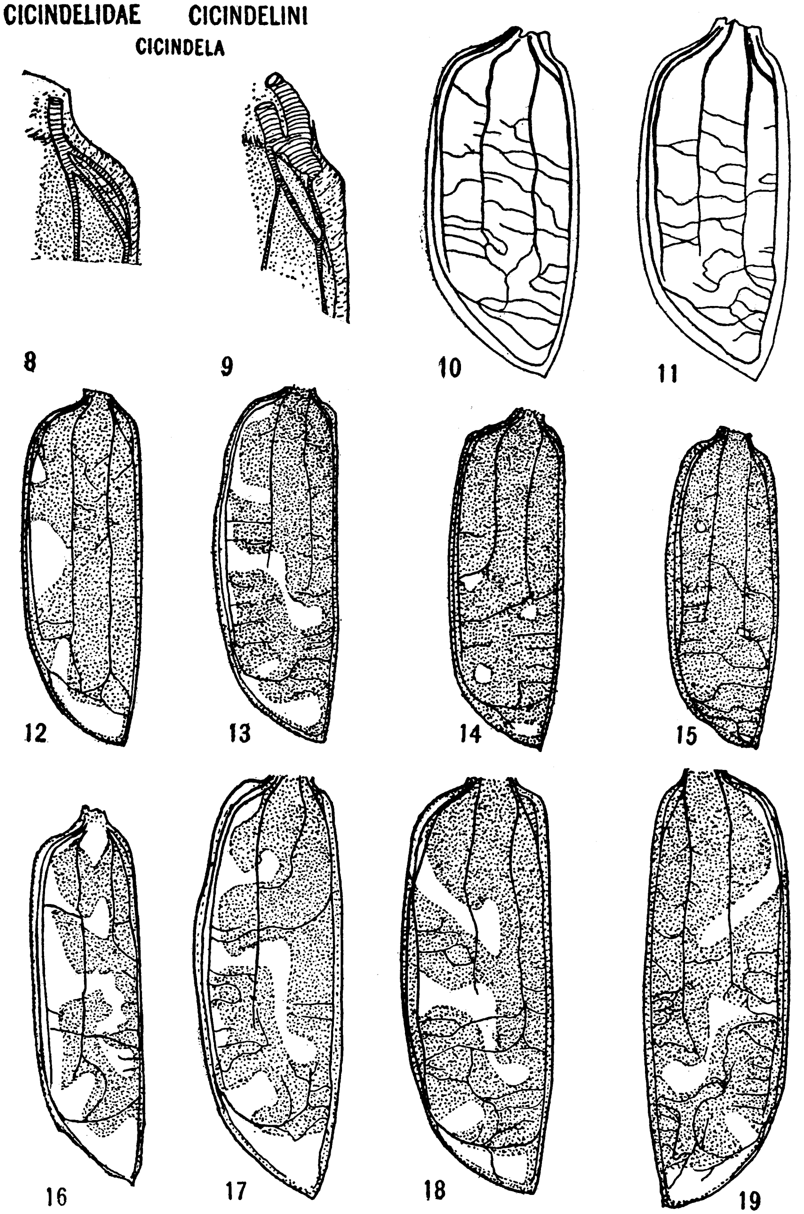


Plate XI

however some thickenings on the under side of the elytra of most species which correspond in a general way to veins (particularly in Mantichora). The outer and inner margins of the elytra are always thickened and resemble veins almost invariably containing tracheæ. The subcosta usually follows the costa very closely at the base of the elytron but just behind the middle it turns inward away from the margin in a vein like thickening. The radius is in a distinct thickening of the elytron which proceeds from the base for a short distance. This is very constantly present. Aside from this nothing comparable to veins is present but the rows of chitinous columns are often so arranged so as to give distinct and direct spaces running the length of wing. These are occupied by the principal trachea. In some cases the spaces appear very clearly on the under side of the elytron and in Mantichora there are distinct ridges over them which have every appearance of veins.

III. TRACHEATION

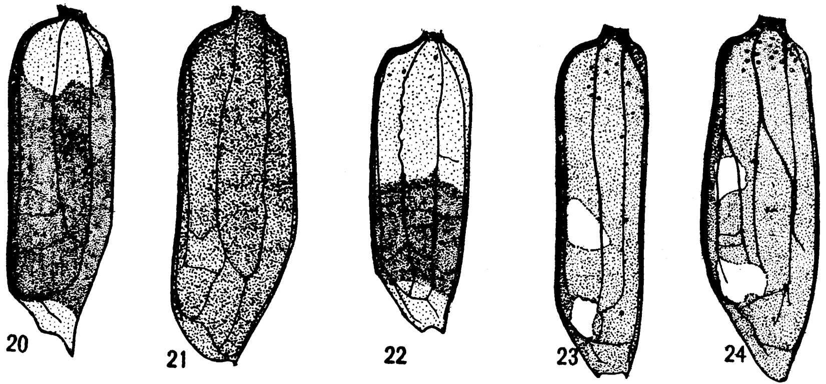
1. *The main trunks*

The six trunks common in insects are represented in but two genera (*Amblychila* and *Mantichora*), (Figs. 4 and 6), which have rudimentary wings and specialized elytra fastened together in the

FIGURES 20-29. THERATIDÆ AND EURYODINI

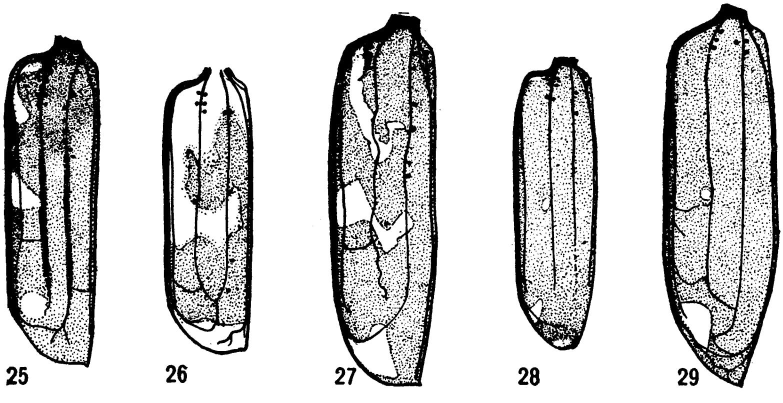
Fig. 20. Therates basalis Dej. (New Guinea).
Fig. 21. Therates labiatus Fab. (Oriental region).
Fig. 22. Therates fasacitus Fabr.
Fig. 23. Eurosopus Chaudoiri, Thom. (South America).
Fig. 24. Eucallia Boussingaulti Cuer. (South America).
Fig. 25. Caledonica acentra Chd. with thickenings in the lines of the trachea. (New Caledonia).
Fig. 26. Distypsidera sp. (New Holland).
Fig. 27. Distypsidera undulata Westw. (New Holland).
Fig. 28. Prothyma adonis sb. sp. bellula Flt. (Madagascar).
Fig. 29. Prothyma versicolor Dej. (N. Africa).

THERATIDAE EURYODINI



THERATES EUPROSOPUS EUCALLIA.

EURYODINI



CALEDONICA DISTYPSIDERA PROTHYMA

PLATE XII

adult. These trachea are demonstrated in the adult dried elytra without any difficulty. In Omus which is closely related to Amblychila the radius and media have disappeared except for rudiments. The cubitus is the principal trachea (Fig. 5). With the exception of Omus and Amblychila it is the anal that has degenerated farthest. Collyris was never very satisfactory for study but it appears that the cubitus is reduced and the anal wanting (Fig. 6). In figure 7 *(Platychila pallida)* the commonest type of tracheation of the family and probably among the most generalized so far as the first four trachea are concerned, is shown. The anal is much reduced.

2. Details of Tracheation in Cicindela

Figures 8 and 9 show two different arrangements of the anal rudiment in Cicindela. In figure 8 it is joined with the cubitus. In figure 9 it is likewise joined in the same place but a small branch suggests a backward extension. The number of small branches and cross connections is large and too variable to be correlated with other specific characters. Figures 10-19 illustrate this fact. Figures 10 and 11 are the two elytra of an individual and show a marked difference. It is evident then that only the main trunks are at all constant. The costal branch at the center the posterior third of the elytron at the beginning of the curve is very characteristic of Cicindela.

FIGURES 30-33. ODOMTOCHILINI

Fig. 30. Oxygonia moronensis Bat. (South America).

Fig. 31. Odontochila punctum Klg.? (South America).

Fig. 32. Odontochila brasiliensis Dej. (South America).

Fig. 33. Prepusa ventralis Dej. (South America).

FIGURES 34-37. DROMICINI

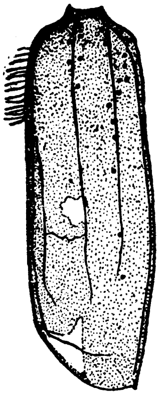
Fig. 34. Dromica Kolbei W. Horn. (South Africa).

Fig. 35. Dromica sculpturata Boh. Thickenings shown as dark areas, not related to the trachea. (South Africa).

Fig. 36. Dromica tuberculata Dej. (South Africa).

Fig. 37. Dromica limbata Bert. (South Africa).

ODONTOCHILINI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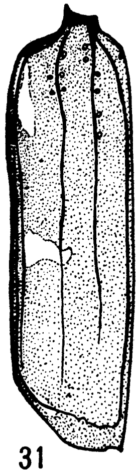
OXYGONIA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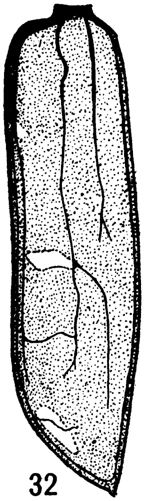
ODONTOCHILA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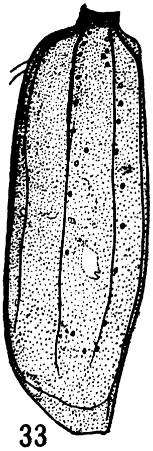
ODONTOCHILA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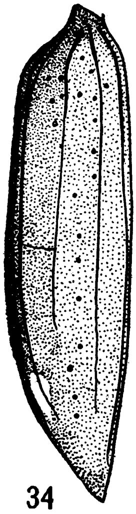
PREPUSA

CICINDELIDAE

DROMICINI

DROMICA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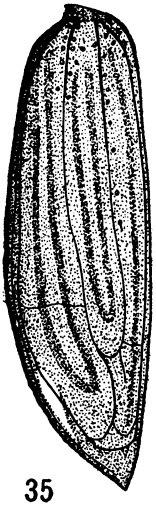
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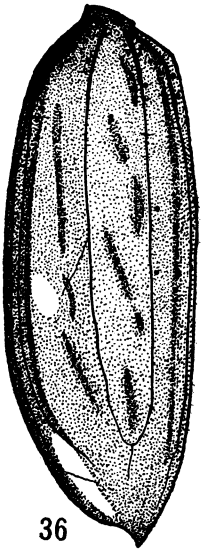
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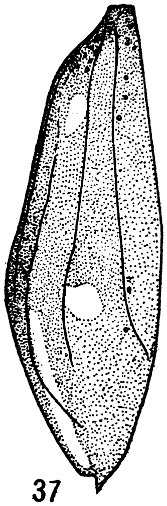
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Plate XIII

3. Peculiarities of the different Taxonomic Groups

The peculiarities or distinguishing features of Cicindela and of the Palæomantichoridæ, Neomantichoridæ, Pognostomidæ, Platychilidæ and Collyridæ have been noted. The remaining families or subfamilies still require mention.

a. Theratidæ. (Figs. 20-21) The radius and media unite in the center of the posterior third of the elytron and are united with the costa and subcosta by three or four branches.

b. Cicindelidæ-Euryodini. (Figs. 23-29) The main trunks are similar to those of Cicindela but differ characteristically in the absence of a costal branch or of its presence near the tip of the elytron than in any other subfamilies. Compare figs. 26-27 with 10-19. In fig. 24 are shown two backward branchings (such as occur in Cicindela). The media appears well developed and joined to the subcosta as a rule.

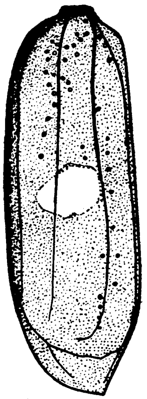
c. Odontochilini. These differ only slightly from the Euryodini but as a rule the media is reduced and the costa joined to the cubitus.

d. The Dromicini appear to have an unbranched and sometimes reduced costa.

e. The Megacephalidæ (Figs. 38-45) are characterized by a well developed media which is as a rule the most prominent trachea of the elytron. The costal branches are somewhat farther posterior than in Cicindela.

FIGURES 38-45. MEGACEPALIDÆ

Fig. 38. Pseudoxychila bipustulata Latr. (South America).
Fig. 39. Oxychila tristis Fabr. (South America).
Fig. 40. Tetracha carolina (Georgia).
Fig. 41. Tetracha carolina Linn. (N. Carolina).
Fig. 42. Styphloderma asperta Wat. (Africa).
Fig. 43. Megacephala (Phæoxantha) limata Perty (South America).
Fig. 44. Megacephala (Phæoxantha) æquinotialis Dej. (South America).
Fig. 45. Megacephala (Phæoxantha) Klugi Chd. (South America).



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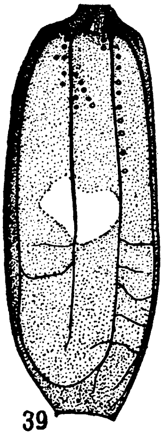
PSEUDOXYCHILA



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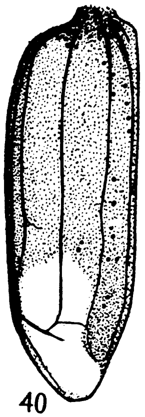
OXYCHILA



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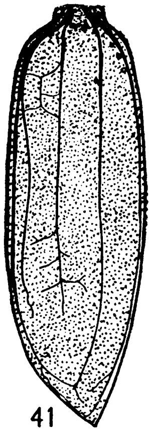
Tetrache **Hope**

MEGACEPHALA



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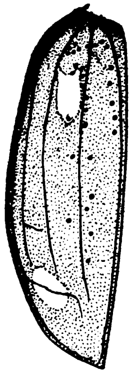
MEGACEPHALA



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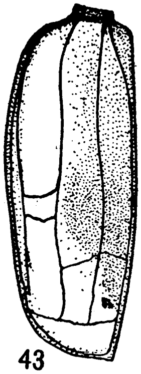
Styphloderma **Wat.**

MEGACEPHALA



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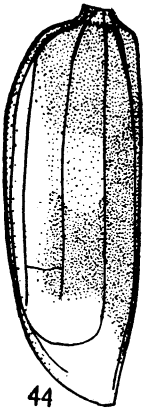
MEGACEPHALA



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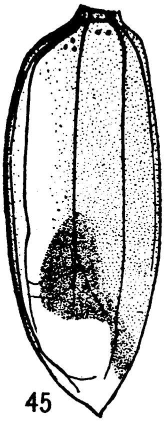
MEGACEPHALA



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MEGACEPHALA

PLATE XIV

In the set of figures facing this page the obvious and presumably more characteristic features of elytral tracheation, brought out in the preceding camera drawings are shown. The figures show characteristic differences between the different groups correlated with the general taxonomic differences. The notable characteristics of the family as a whole is the tendency to reduce the anal. The exception falls in the Mantichorid groups which are wingless and have the most specialized elytra. The figures show conclusively that tracheation is far from haphazard, that it is of a fairly constant taxonomic significance in this group of Coleoptera.

It has been shown that veins are formed in the development of elytra before the trachea enter. Accordingly no claim of exact homology with the corresponding veins of other orders is made.

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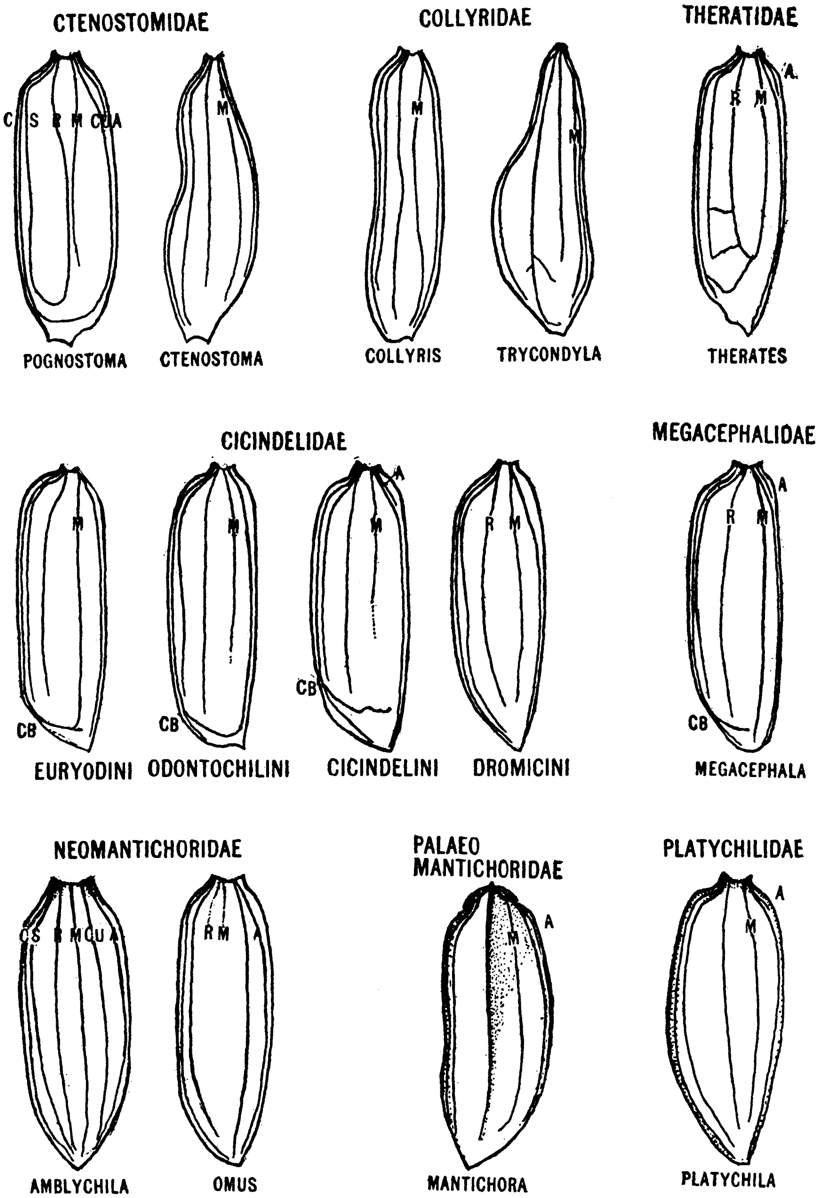
CTENOSTOMIDAE
C S R M CU A
M
POGNOSTOMA
CTENOSTOMA
COLLYRIDAE
M
M
COLLYRIS
TRYCONDYLA
THERATIDAE
A
R M
THERATES
CICINDELIDAE
M
CB
EURYODINI
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CB
ODONTOCHILINI
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CB
CICINDELINI
R M
DROMICINI
MEGACEPHALIDAE
A
R M
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MEGACEPHALA
NEOMANTICHORIDAE
CS R M CU A
R M A
AMBLYCHILA
OMUS
PALAEO MANTICHORIDAE
A
M
MANTICHORA
PLATYCHILIDAE
A
M
PLATYCHILA

PLATE XV